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Association of Blood Pressure and PCB Level in Yusho Patients

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Correlations of blood polychlorinated biphenyl (PCB) levels or PCB patterns and blood pressures were studied in 59 patients with Yusho (PCB poisoning) above 40 years old. In spite of the passage of 13 years from the onset, 52.5% of these patients still have PCB levels higher than the range found in the general population. The frequency of hypertension in the patients was 16.9%, a value similar to that expected on the basis of the rate for a population of the same age and sex compositions.

As an independent variable, the blood pressure of patients was not associated with blood PCB levels and PCB patterns. No PCB blood pressure association was confirmed in 20 patients with PCB levels persistently higher than 5 ppb for 9 years. On the other hand, age, obesity and habitual alcohol intake, known influencing factors for hypertension, tended to be positively associated with elevated blood pressure in these Yusho patients.

Introduction

An outbreak of Yusho, subacute poisoning, in the western part of the Japanese archipelago in 1968, was caused by the ingestion of Kanemi oil accidentally contaminated with polychlorinated biphenyls (PCBs). A review of past and current medical states of the Yusho patients was reported by one of the authors (*1*). Blood PCB concentrations and patterns still remained at high levels and retained the characteristic patterns after about 13 years.

Kreiss et al. (*2*) reported recently that persons with higher serum PCB levels tended to have elevated blood pressure and that the association was independent of age, sex, body mass index and social class. Serum PCB levels in their population, however, were relatively low, and accumulation of PCBs in the body with age seemed to be related to hypertension. Further studies of other groups with PCB exposure are needed to determine whether PCBs affect blood pressure. In this study, the associations of blood PCB level or PCB pattern and blood pressure were examined in Yusho patients with persistently elevated PCB levels regardless of age.

Methods

Annual follow-up studies of Yusho patients have been conducted in Fukuoka Prefecture and were performed in 1981. Blood PCB levels and blood pressures were measured in 59 patients above 40 years old not receiving antihyperpensive treatment. Blood PCB levels and PCB patterns were measured as described in previous papers (*3,4*). Hypertension was defined as a systolic measurement of 160 mm Hg or higher and/or a diastolic measurement of 95 mm Hg or higher. The Quetelet index for obesity was calculated from weight (kg)/height (m) (*2,5*). Student's t test was used to find the significance between the mean values.

Age, obesity and alcohol consumption are known to be contributing factors to elevations of blood pressure (*6*). The average age was 56.6 years old (Table 1). Obesity and habitual alcohol intake were found in 20 and 40% of the study group, respectively, and the frequency of patients having PCB levels higher than 5 ppb in healthy persons was 52.5% (Table 1).

About 20 Yusho patients persistently showed PCB levels higher than 5 ppb from 1974 to 1981. Changes of blood pressure and PCB level were also studied.

Results

Blood PCB Level and Blood Pressure

Blood PCB levels (mean ± SD) of Yusho patients were 5.1 ± 2.3 ppb for males and 6.4 ± 5.3 ppb for females and were not positively related to age. On the other hand, frequenies of hypertension in the patients were 20.0% for males and 14.7% for females, respectively (Table 1).

Correlations of blood PCB levels and blood pressure were studied. The blood pressures were not asociated with blood PCB levels for either males (r = 0.042, N =

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Table 1. Clinical data of patients with Yusho.

Sex	No. of cases	Age, yr[a]	Abnormal PCB level, %[b]	Obesity, %[c]	Alcoholics, %[d]	Hypertension, %
Male	25	57 ± 10	52.0%	20.0%	40.0%	20.0%
Female	34	56 ± 10	52.9	20.6	0.0	14.7
Total	59	57 ± 10	52.5%	20.3%	—	16.9%

[a]Mean ± SD.
[b]Having higher levels than 5 ppb.
[c]Obesity was defined as a Quetelet index of 25.4 or higher.
[d]Habitual alcohol intake more than 20 g alcohol per day.

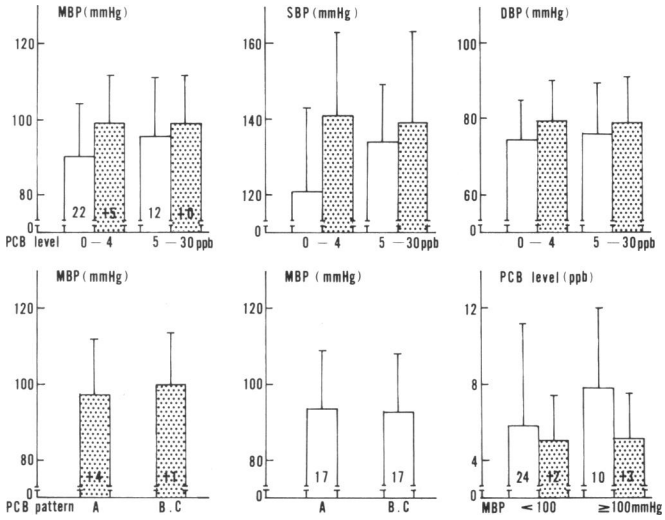

FIGURE 1. Association of blood pressures and PCB levels or PCB patterns in 59 patients with Yusho: (▩) male subjects; (□) female subjects; numbers represent number of patients in group.

25) or females (r = 0.216, N = 34). Also, no PCB–blood pressure association was confirmed in each observation when mean, systolic and diastolic blood pressures were analyzed (Fig. 1).

Blood PCB Patterns and Blood Pressure

Gas chromatographic patterns of blood PCBs were classified into three patterns: (A) patterns peculiar to Yusho patients; (B) a pattern resembling (A) and (C) a pattern similar to that of normal subjects (4). The blood pressures of patients with the A pattern were similar to those of patients with B and C patterns (Fig. 1).

Changes of Blood PCB Level and Blood Pressure

In 20 patients with persistently elevated PCB levels (>5 ppb) for about 8 years, the PCB–blood pressure association was studied. It was confirmed in each patient that follow-up blood pressures were not associated with blood PCB levels (Fig. 2).

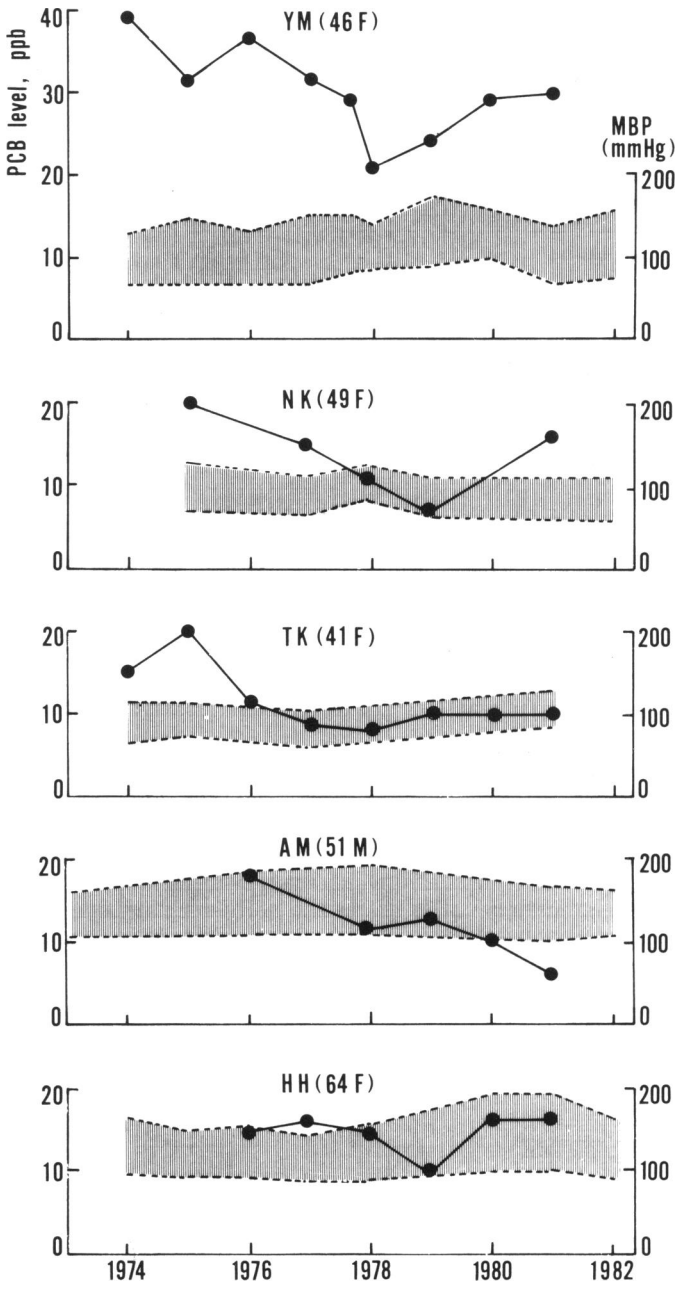

FIGURE 2. Follow-up study of blood pressures and PCB levels in five patients with Yusho. Shaded areas show ranges of systolic and diastolic blood pressures.

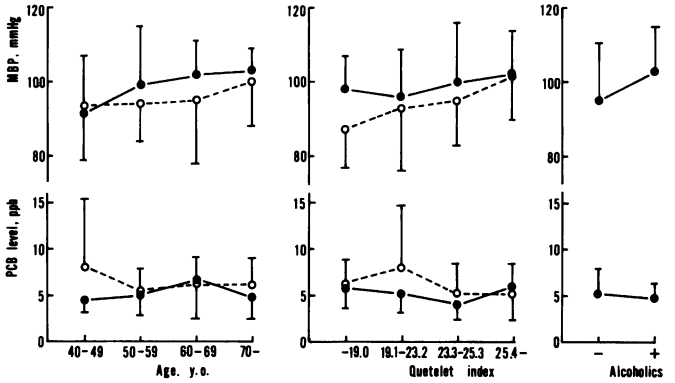

FIGURE 3. Blood pressures and blood PCB levels by age, Quetelet index and alcohol consumption in 59 patients with Yusho : (●) male; (○) female.

Age, Obesity or Habitual Alcohol Intake and Blood Pressure

Age, obesity and alcohol consumption are known influencing factors for hypertension (*6*). The blood pressures (mean blood pressures) of Yusho patients tended to be positively correlated with these factors (Fig. 3). Blood PCB levels in patients, on the other hand, were independent of age, obesity and alcohol consumption (Fig. 3).

Discussion

In 1981, Kreiss et al. (*2*) reported an association of blood pressure and PCB level in a community-wide study in Triana, AL (U.S.). Serum PCB levels in their study were relatively low, and 80 to 90% of 458 persons had levels within the range found in other community groups. They found the contribution of PCBs to the systolic measurement was small and of borderline statistical significance; however, the association of PCBs concentration to the diastolic measurement was clearly significant. Serum PCB levels of these persons were found to be positively related to age, known as a contributing factor of hypertension. Therefore, further examinations are needed to determine whether PCBs affect blood pressure.

In this study, the PCB–blood pressure association was examined in 59 Yusho patients 15 years after the onset. In 52.5% of the cases, PCB levels were still higher than the range found in the general population. The frequency of hypertention in the patients, however, was found to be 16.9%, which was similar to the values expected on the basis of the rate for a population of the same age and sex composition (*5*). Additionally, the blood pressures were not found to be related to blood PCB levels or PCB patterns. The changes in blood pressures in each patient followed up for 9 years were not associated with the blood PCB levels. On the other hand, blood pressures of the patients tended to be positively associated with age, obesity or alcohol comsumption and had no connection with blood PCB level.

Okumura et al. (*7*) reported that blood pressures in 18 severely ill Yusho patients within 6 months after the onset were all in the normal range. Blood PCB levels could not be measured at that time; however, the levels might be strikingly higher than those at present. We could not confirm the aspect that PCBs affect blood pressure in these Yusho patients having higher PCB levels than those in Kreiss's study (*2*).

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